

Spacesuit Reach Capability and Work Volume Assessment

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Work volumes and reach envelopes define the locations where work objects or interfaces can be placed around a person to reduce ergonomic risk. Spacesuits, however, show unique reach patterns, due to the stiffness and mechanical constraints from pressurization. This study measured the reach motion patterns and capabilities from subjects wearing a pressurized spacesuit using a 3D motion capture system. The subjects performed arm and hand motions, focusing on extreme lateral and vertical positions. These motions defined the maximum ranges. They also performed on-suit reaches to measure where they could or couldn't reach on the suit surface to determine where critical controls and devices could be placed on the suit. A parametric model of the reach volume was statistically built using the collected hand position data. The observed shape and size of the work volume substantially vary by persons, depending on anthropometry and strength capability. It was also indicated that the traditional metrics (e.g., simple spherical or cylindrical representations) estimated from "unsuited" persons or computer simulations may not accurately capture such variations. The results of this study can help to design and optimize space hardware and task activities, to protect crewmembers from overexertion or injuries.